Submitted to:
US EPA Region 8
Denver, CO

Submitted by:
Atlantic Richfield Company
La Palma, CA
July 3, 2012

Supplement to Investigation Plan for Collapsed Adit Area at St. Louis Tunnel

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Atlantic Richfield Company

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July 3, 2012

VIA EMAIL AND HAND DELIVERY

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
U.S. EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

RE: Supplement to Investigation Plan for Collapsed Adit Area at St. Louis Tunnel, Rico-Argentine Mine Site – Rico Tunnels, Operable Unit OU01 Rico, Colorado EPA Unilateral Administrative Order, Docket No. CERCLA-08-2011-0005

Dear Mr. Way,

A digital file in PDF format of the Supplement to Investigation Plan for Collapsed Adit Area at St. Louis Tunnel, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado dated July 3, 2012 is being submitted to you today via email. Three (3) hard copies of the report will also be hand-delivered to your office on July 3.

Atlantic Richfield Company (AR) is submitting this report responsive to requirements in Task D – Hydraulic Control Measures for the Collapsed Area of the St. Louis Tunnel Adit / Subtask D1 – Adit Collapse Area Investigations of the Remedial Action Work Plan accompanying the Unilateral Administrative Order for Removal Action, Rico-Argentine Site, Dolores County, Colorado, U.S. EPA Region 8, Docket No. CERCLA-08-2011-0005.

If you have any questions or comments, please feel free to contact me at (714) 228-6770 or via email at Anthony.Brown@bp.com.

Sincerely,

Anthony R. Brown

Tony Brown
Project Manager
Atlantic Richfield Company

Enclosure (Supplement to Investigation Plan for Collapsed Adit Area at St. Louis Tunnel)

cc: Terry Moore, Atlantic Richfield
Sandy Riese, EnSci
Chris Sanchez, AECI
Dave McCarthy, Copper Environmental
Tom Kreutz, AECOM
Doug Yadon, AECOM

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for
Collapsed Adit Area at St. Louis Tunnel
at
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Rico, Colorado

July 3, 2012

1.0 Objectives

The primary objectives of this Supplement to Investigation Plan for Collapsed Adit Area at St. Louis Tunnel (Supplement to what is referred to informally as the Adit Investigation Plan - AIP) are to: 1) provide information to support design of a hydraulic control system for discharges from the St. Louis Tunnel; 2) investigate the condition of the collapsed portion of the adit and how it interfaces with competent rock at the brow of CHC Hill; 3) provide an access point far enough behind the blockage (via the borehole casing) to measure typical water depth and gather discrete samples for tracer/flowrate measurements (if feasible); and 4) further assess the possible accumulation of settled solids and water build-up behind the existing blockage in the collapsed area (if feasible). Investigations to achieve these objectives are focused on collecting, controlling, and conveying the adit flow from its current point of discharge to a future water treatment facility, currently assumed to be upgradient of the existing Pond 18.

The objectives described above for the current study will be met by implementing the tasks described in the subsequent sections of this Supplement to AIP. Note that the tasks are described in the general order in which they will be performed, with the understanding that some of the tasks may overlap. Subsequent tasks may change based in part on the results of precedent tasks.

2.0 Background

Conditions at the collapsed portion of the St. Louis Tunnel upgradient of the existing portal structure are described in the original AIP (Atlantic Richfield Company, 2011a) and in a report of the findings of the investigations to date implemented under that plan (Atlantic Richfield Company, 2011b). As shown on Figure 1 and Figure 2, results from drilling under the original AIP and historic information found in archival records subsequent to the field exploration performed last year confirm that Hermosa Formation bedrock is present at approximate tunnel Station 3+20. It is apparent that the St. Louis tunnel originally penetrated colluvium/talus for approximately 300 feet horizontally between the upgradient side of the portal structure and the bedrock contact. Approximately 40 feet of original and overlying displaced colluvium/talus is now present above the contact with Hermosa Formation bedrock as seen on Figure 1. The colluvium/talus where penetrated by borings AT-2 and BAH-01 (Atlantic Richfield Company, 2011b) is a heterogeneous mixture of predominantly coarse-grained, low plasticity to non-plastic soil with occasional large rock blocks. As described in Atlantic Richfield Company (2011b) and shown on the historic tunnel geologic mapping presented on Figure 2, the bedrock near the contact with the colluvium/talus is locally sheared and faulted, and lagging is indicated to extend approximately 40 feet into the bedrock section of the tunnel. There is also a mapped 33-foot wide fault zone approximately 110 feet further into the tunnel from the bedrock contact with the colluvium/talus from approximately Station 4+30 to 4+65.

As previously inferred, it is apparent from drilling and sampling of boring AT-2 (Atlantic Richfield Company, 2011b) that the collapsed debris at the upgradient end of the open portion of the remnant tunnel is impounding mine drainage and that precipitated solids are accumulating on the tunnel floor in the ponded reach. The possibility exists that other collapsed reaches are present but not yet encountered in the limited exploration performed to date.

3.0 Investigation Tasks

3.1 Compile, Review and Evaluate Existing Data

The following existing information has been reviewed and evaluated to support the planning and implementation of further investigations under this task and the subsequent preliminary design of hydraulic control structures/facilities under Work Plan Task D.

- Grade and alignment of the St. Louis Tunnel and the subsequent excavations and apparent "collapse" of the portal area and lower tunnel reach (from existing historic mine plans and maps, and aerial photography from 14 years between 1950 and 2011)
- Geology of the portal area and lower tunnel reach from published geologic mapping and reports, and site reconnaissance geologic mapping
- Results of the 2011 site exploration and laboratory testing

3.2 Monitor Water Levels in the St. Louis Tunnel

The pressure transducer previously installed in boring AT-2 in the colluvium/talus reach of the tunnel will continue to be monitored and the results converted to water level (depth and elevation) in the tunnel at that location. An attempt will be made to install a pressure transducer in the tunnel through the casing and cored bedrock reach of boring BAH-01. The pressure transducer data is intended to collect seasonal data on variations in water level and hydraulic pressures in the St. Louis Tunnel. This data will be used to develop alternatives for potential hydraulic controls at the St. Louis Tunnel.

Pressure transducers will also be installed, if possible, in any inclined borings to be drilled as described in Section 3.4.1 that are successful in penetrating the St. Louis Tunnel.

3.3 Slope Movement Monitoring

One line of two to three embedded Slope Acceleration Arrays (SAA-101, SAA-102 and SAA-103) will be installed at 30- to 50-feet on-center over the tunnel alignment in the colluvium/talus slope above the "adit collapse" area (see Figure 3). The SAAs are installed either vertically or perpendicular to the slope, using a drill rig to advance a hollow-stem auger or cased drill hole to within a few feet of the crown of the tunnel (varying from about 10 to 50 feet deep). Each array, which is comprised of multiple x-y-z movement sensors at one-foot spacing, is placed inside a thin-wall PVC electrical conduit and slid into the cased borehole. The hole is then backfilled with a pliable bentonite/cement grout as the casing or auger is extracted. Once installed, cabling can be extended from the arrays down the slope to a remote location that is read manually, or an antenna with a solar cell can be installed on each array to read on a quasicontinuous basis via telemetry. This data will be used during the design phase of the tunnel alternative to assess ongoing creep of the talus/colluvium slope just above the proposed new tunnel to plan appropriate support/shoring methods, and can then be used as a primary safety warning system for slope movement during the tunnel construction.

Safety issues prevent the installation of the preferred number of SAA arrays at the appropriate locations as part of this Supplemental AIP investigation. If this is the case, then additional fill may be placed in the horseshoe-shaped excavation during the initial phase of construction to stabilize the lower portion of the existing slopes, thus providing a working platform above the tunnel alignment to allow additional SAAs to be installed prior to advancing the tunnel.

3.4 Geophysical Surveys

Three lines of refraction microtremor (ReMi) profiles (RM-201, RM-202 and RM-203) will be completed, one parallel to and two perpendicular to the open portion of the tunnel, just west of the collapse area (see Figure 3). Ambient vibrations from nearby sources such as moving vehicles and equipment result in shear and compression wave returns from subsurface materials to a linear array of geophones placed on the ground surface along the profile to be explored. These returns are assembled into a response spectrum that is analyzed by computer to evaluate shear and compression wave velocities (and thereby an index of density) of overburden materials and the approximate depth to interfaces of materials of varying density (e.g., competent strata such as intact bedrock). This information will be utilized to help characterize the apparent variation in density of the colluvium/talus as one of the bases for estimating shear strength for stability analyses.

3.5 Geotechnical Drilling

3.5.1 Inclined Borings

The objective of this work is to support design and bidding for potential new tunneling to access the reach of the existing St. Louis Tunnel where hydraulic control works need to be installed. The primary conditions to be investigated are confirmation of the nature and extent of colluvium/talus and the inferred lower quality bedrock just east of the brow (contact of rock under the colluvium/talus) that required lagging during original tunnel construction (as shown on Figure 2). Two (2) inclined borings (CHI-101 and CHI-102) will be drilled at the appropriate angle from the horizontal to intercept the portion of the tunnel just upgradient of the contact between the colluvium/talus and bedrock that is reportedly lagged and characterized by local sheared/faulted rock. Pending the results of these two borings, a third boring (CHI-103) may be drilled to investigate conditions at the fault zone located further into the tunnel as described previously. The objective of this third boring would be to assess if support is needed in the faulted reach to further protect the integrity of the hydraulic control structure currently envisioned to be located in bedrock close to the colluvium/talus contact.

Given the geometric and safety constraints of the "adit collapse" area, two potential drill pad locations (from among six locations originally evaluated) from which the CHI-series borings could be drilled (as shown on Figure 4) and three drilling methods are currently being evaluated. The drilling methods under consideration to penetrate the talus/colluvium and then core the Hermosa Formation bedrock, all using a track- or skid-mounted drilling rig, include: sonic drilling; ODEX hammer drilling with casing advance; and traditional mud rotary drilling and driven casing. Each method has benefits and obstacles given the challenging site conditions. If the rig can be sited at a location to accommodate the limitations on the inclination of the drill string, the sonic method is judged to be the fastest and best method to penetrate the colluvium/talus and encounter the tunnel, for the particular conditions anticipated. Once the colluvium/talus is penetrated and cased, the intact bedrock will be sampled by traditional N-size wireline coring.

An assessment will be made of the risks associated with this drilling prior to implementation, including raveling/rolling of colluvium/talus (including cobble to boulder size rocks) from the surrounding excavation slopes and collapse of debris into the underlying remnants of the tunnel due to the imposed load of the drill rig. Appropriate measures will be implemented to provide for the safety of the drilling operations.

If the ODEX or conventional mud rotary drilling method is used, then geotechnical sampling of the overburden talus/colluvium as the holes are advanced is not practical for the inclined drilling. In this case, information on the physical properties of the materials encountered will be based on drill action and the experience of the driller and the professional logging the drill hole and cuttings. The nature of the drill action (smooth, chattering, etc.), rate of penetration, color of the drill cuttings, and the presence of free water in the drilling return will be recorded. Special attention will be paid if refusal or marked change in drill action or penetration rate is encountered.

If these borings are successful in encountering the tunnel, they will also be used if possible to measure the depth of and sample solids and water upstream of the collapse area, and to install pressure transducers to monitor water levels. In addition, a borehole camera and/or other imaging device will be used to examine in situ conditions to the degree practical (including the open tunnel if encountered and/or the uncased bedrock section penetrated in the boring).

3.5.2 Vertical Boring

One vertical exploratory boring (CHV-101) will be located between the portal structure and the collapsed part of the tunnel, starting at approximately the level of the top of the open part of the tunnel (El. 8860+/-). This boring will be advanced using mud-rotary drilling methods, sampled at typical 5-foot intervals through the talus/colluvium, and cored up to 20 feet into intact bedrock. The boring will be completed with two piezometers, one to measure the water level in the bedrock and the other to measure the water level in the talus/colluvium. The piezometers will be constructed of factory slotted 2-inch nominal diameter PVC well screen; 5-foot screen length is assumed pending the results of the drilling. Alternatively, a well screen can be set in bedrock in the first hole, and a companion hole blank drilled nearby through the colluvium only, and fitted with a second well screen in that zone. Pressure transducers will be installed to monitor water levels in each screened interval at a frequency that will allow an assessment of the response of groundwater levels to precipitation events and flow in the St. Louis Tunnel.

The primary purpose of these water level measurements is to determine if the flowing water observed in the open section of the tunnel is perched above the water level in the surrounding talus/colluvium, and if there is vertical connectivity between the water levels in the colluvium/talus and underlying bedrock.

3.5.3 Monitoring Wells

To further evaluate groundwater conditions at the potential tunnel grade to support design of appropriate temporary support and permanent lining, including contributions of flowing mine water from the open section of the tunnel into the talus/colluvium along the proposed tunnel alignment, four (4) geotechnical monitoring wells (MW-201, MW-202, MW-203 and MW-204) will be installed. Borings will be drilled and sampled from the existing grade to bedrock using the sonic method. Open standpipe-type piezometers will be installed with screened (slotted) intervals within the colluvium/talus section selected based on the conditions encountered during drilling. The piezometers will be constructed with 2-inch nominal diameter factory slotted PVC pipe with appropriate sand packs and bentonite seals.

3.5.4 Drilling and Sampling Methods

Refer to Section 4.2.10 in the Supplement to FSP (Atlantic Richfield Company, 2012). Note that a minimum of 210 feet (300 feet if targeting the fault zone) of RD drill pipe and sonic tubing will be available on site to accommodate estimated potential drilling depths.

3.5.5 Handling and Custody of Sampling

Refer to Section 4.2.11 in the Supplement to FSP (Atlantic Richfield Company, 2012).

3.6 Laboratory Testing

3.6.1 Geotechnical Testing

Samples of colluvium/talus from sonic borings will be tested for index properties (moisture content, gradation, and if plastic, Atteberg limits) and for laboratory moisture-density relationship (i.e., Proctor density testing). In addition, direct shear or possibly triaxial shear strength testing will be performed on samples prepared in the laboratory to represent approximate in place density for slope stability analysis. Selected samples of rock core will be acquired from the inclined and vertical borings described above for laboratory testing. Depending on the characteristics of core recovered, testing may include specific gravity, density, unconfined compressive strength, and indirect splitting tensile strength.

3.6.2 Water and Solids Testing

Water samples, if any are collected, will be tested for the full suite of analytes for surface water presented in the project SAP and additional parameters to be identified and proposed for concurrence by EPA that may be helpful in assessing the possible source(s) of the water. If solids samples are collected, they will be tested for the suite of parameters tested for in Boring AT-2.

4.0 References

Atlantic Richfield Company. 2011a. Investigation Plan for Collapsed Adit Area at St. Louis Tunnel, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado; submitted to US EPA, Region 8, Denver, CO. August.

Atlantic Richfield Company. 2011b. 2011 Investigations, Analyses and Evaluations (Part D – Adit and Portal Investigation Report). Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado; submitted to US EPA, Region 8, Denver, CO. December.

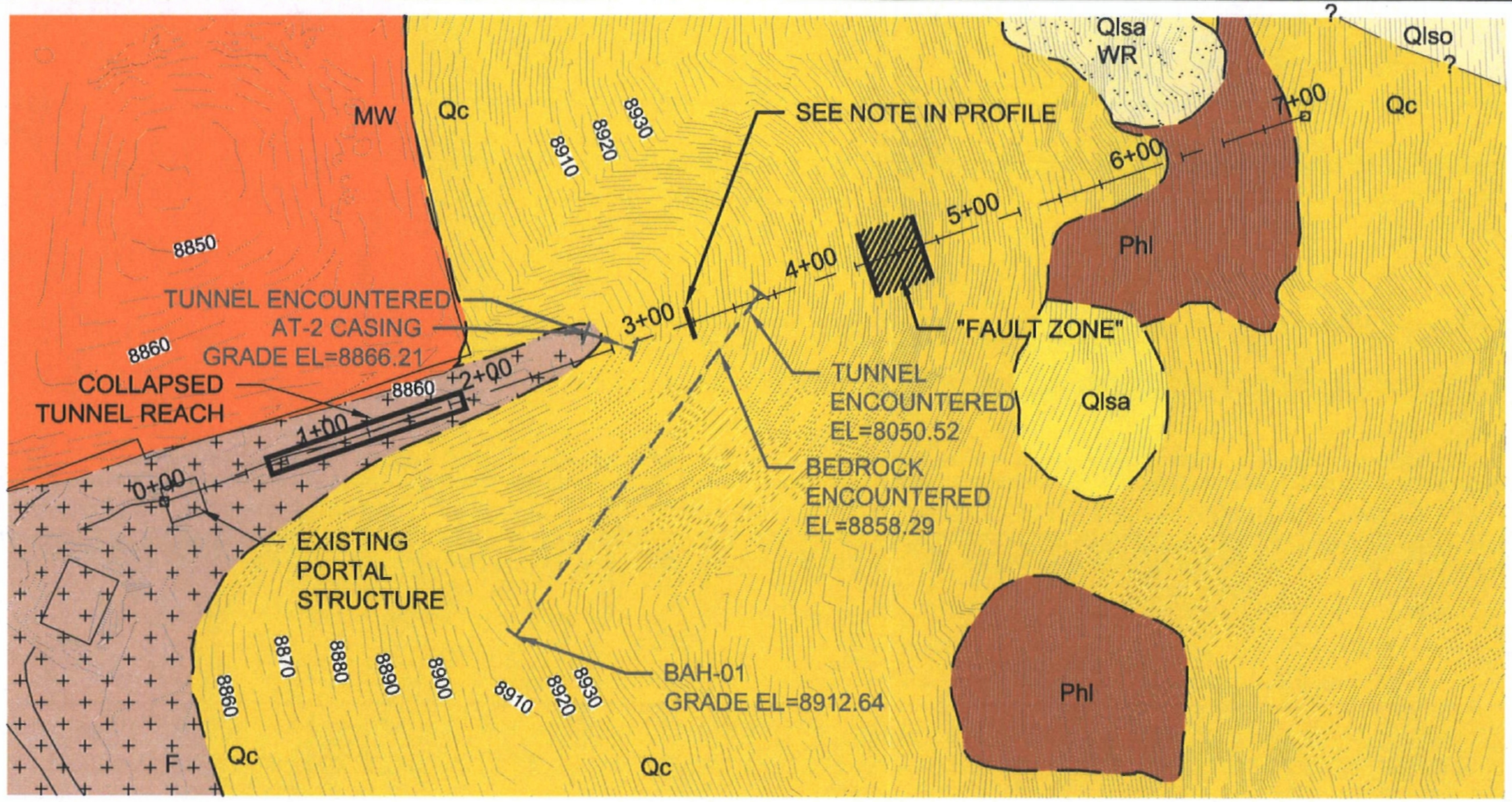
Atlantic Richfield Company. 2012. Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility, and Flood Dike and Pond Embankment Improvements, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado; submitted to US EPA, Region 8, Denver, CO. July.

TABLES

Table 1. 2012 Field Investigation Schedule

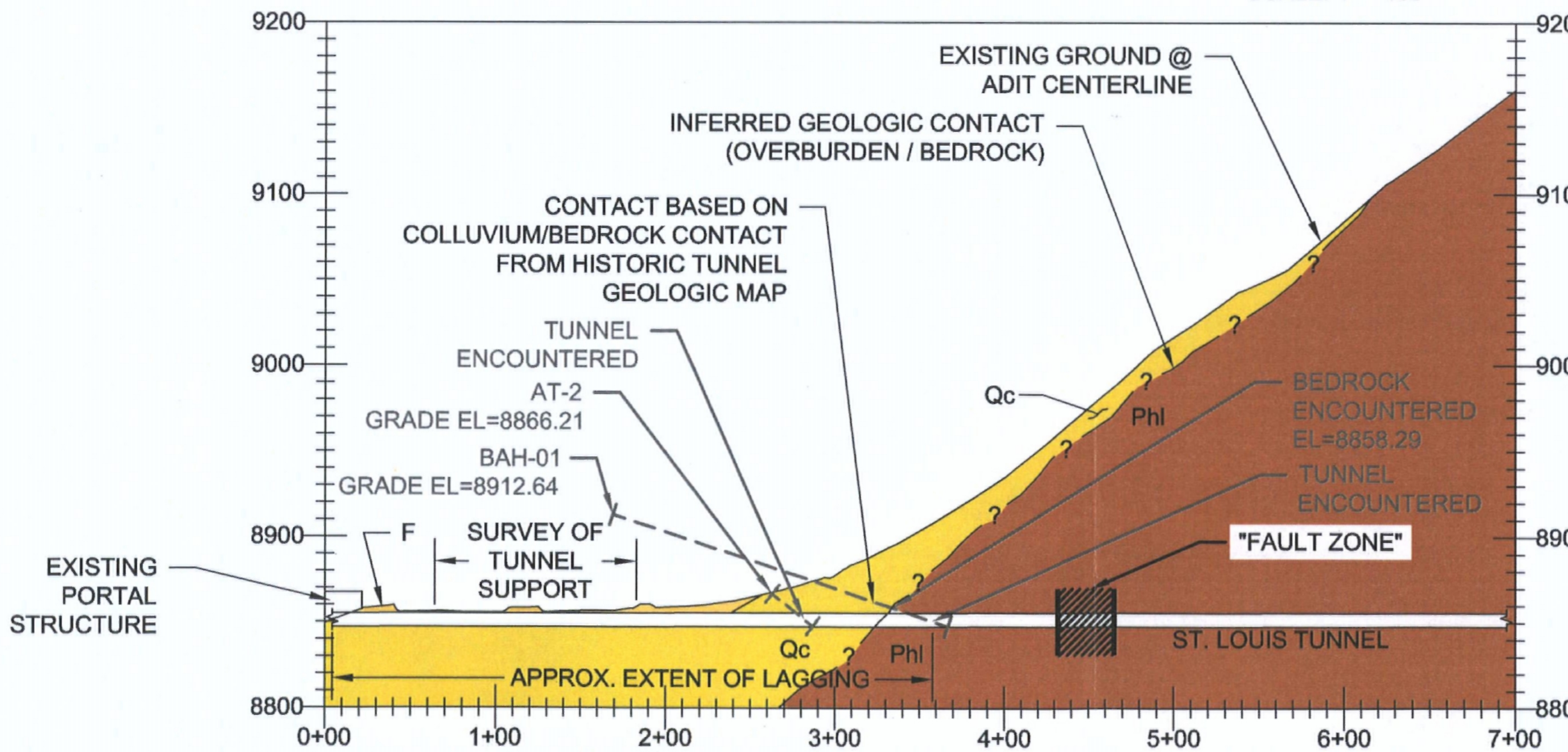
Exploration No.	General Location	Depth (Estimated)	Rig Type	Complete as Monitoring Well?	Notes
CHV-101	Collapsed adit area	As needed for 20 ft into bedrock	Mud Rotary	Yes, dual completion	Vertical boring
CHI-101	TBD (see Figure 4)	TBD ft (est.) to existing tunnel	TBD (Sonic, ODEX or Mud Rotary)	Yes, casing remains	Inclined boring using skid or track rig
CHI-102	TBD (see Figure 4)	TBD ft (est.) to existing tunnel	TBD (Sonic, ODEX or Mud Rotary)	Yes, casing remains	Inclined boring using skid or track rig
CHI-103	TBD (see Figure 4)	TBD ft (est.) to tunnel/fault zone	TBD (Sonic, ODEX or Mud Rotary)	Yes, casing remains	Inclined boring using skid or track rig
MW-201	North side of collapsed adit	100 ft or bedrock surface	Sonic	Yes	Screen well based on conditions encountered during drilling
MW-202	South side of collapsed adit	100 ft or bedrock surface	Sonic	Yes	Screen well based on conditions encountered during drilling
MW-203	South side of collapsed adit	100 ft or bedrock surface	Sonic	Yes	Screen well based on conditions encountered during drilling
MW-204	North side of collapsed adit	100 ft or bedrock surface	Sonic	Yes	Screen well based on conditions encountered during drilling
RM-201	Parallel to north side of collapsed adit	Min. 150 ft	N/A	N/A	ReMi profiles by AECOM
RM-202	Across axis of collapsed adit	Min. 150 ft	N/A	N/A	ReMi profiles by AECOM
RM-203	Across axis of collapsed adit	Min. 150 ft	N/A	N/A	ReMi profiles by AECOM
SAA-101	On colluvial/talus slope above tunnel	10-40 ft (est.)	Mud Rotary (or Sonic)	N/A	Blank drill to install and grout instruments using skid or track rig
SAA-102	On colluvial/talus slope above tunnel	10-40 ft (est.)	Mud Rotary (or Sonic)	N/A	Blank drill to install and grout instruments using skid or track rig
SAA-103	On colluvial/talus slope above tunnel	10-40 ft (est.)	Mud Rotary (or Sonic)	N/A	Blank drill to install and grout instruments using skid or track rig

FIGURES



PLAN
SCALE: 1"=100'

SCALE: 1" = 100'



PROFILE
SCALE: 1"=100'

SCALE: 1" = 100'

LEGEND:
- FILL
- MINE WASTE
- WASTE ROCK
- Phl
- Qc
- Qlso
- Qlsa

PLAN AREA

KEYMAP
NOT TO SCALE

PRELIMINARY

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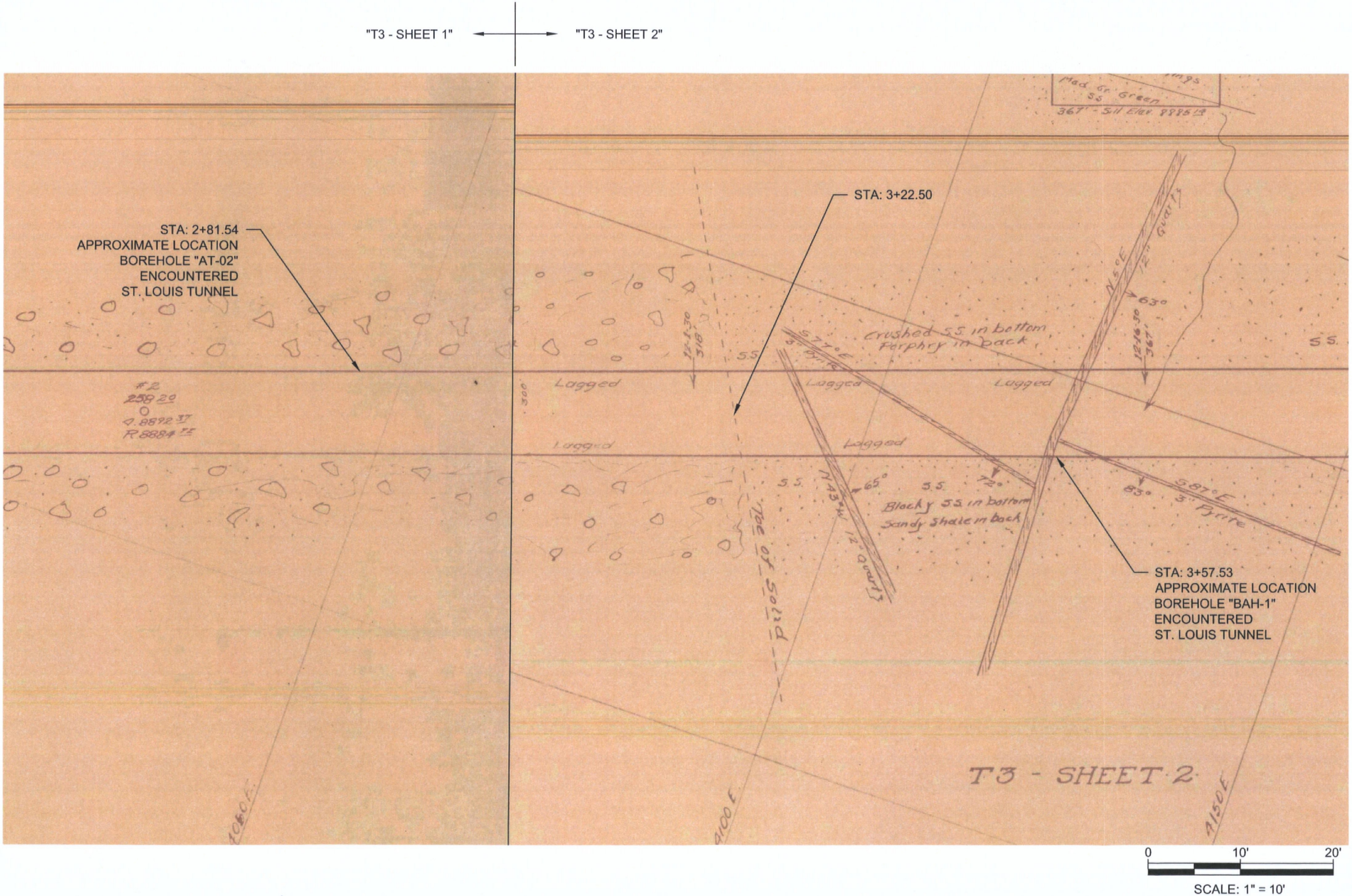
RICO-ARGENTINE SITE-OU01
2012 ADIT INVESTIGATION PLAN SUPPLEMENT
FIGURE 1 - ADIT COLLAPSE AREA GEOLOGIC PLAN & PROFILE



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RICO-ARGENTINE SITE-OU01

2012 ADIT INVESTIGATION PLAN SUPPLEMENT

FIGURE 2 - HISTORIC TUNNEL GEOLOGIC MAP

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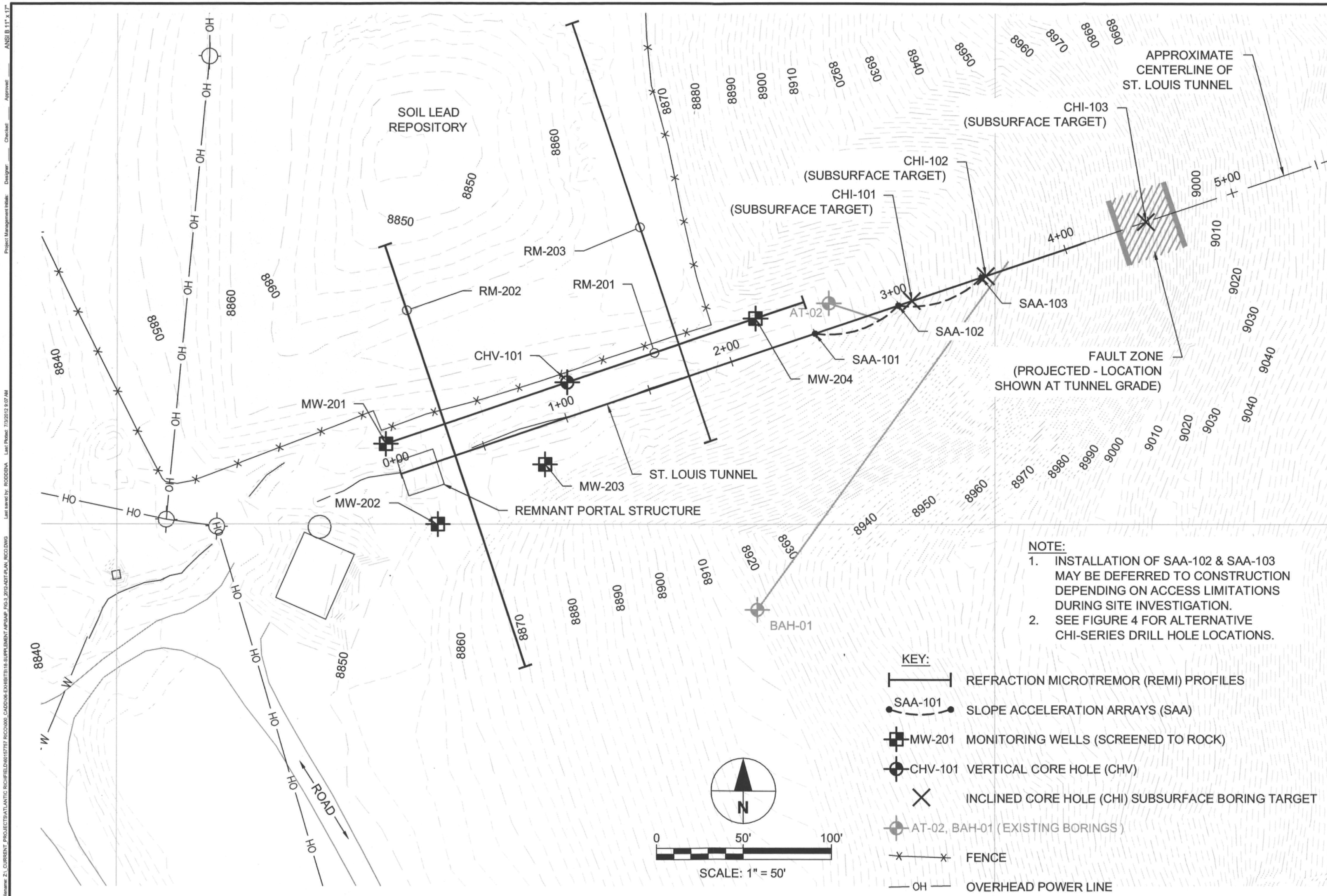

RICO-ARGENTINE SITE-OU01
2012 ADIT INVESTIGATION PLAN SUPPLEMENT
FIGURE 3 - 2012 FIELD INVESTIGATION PLAN

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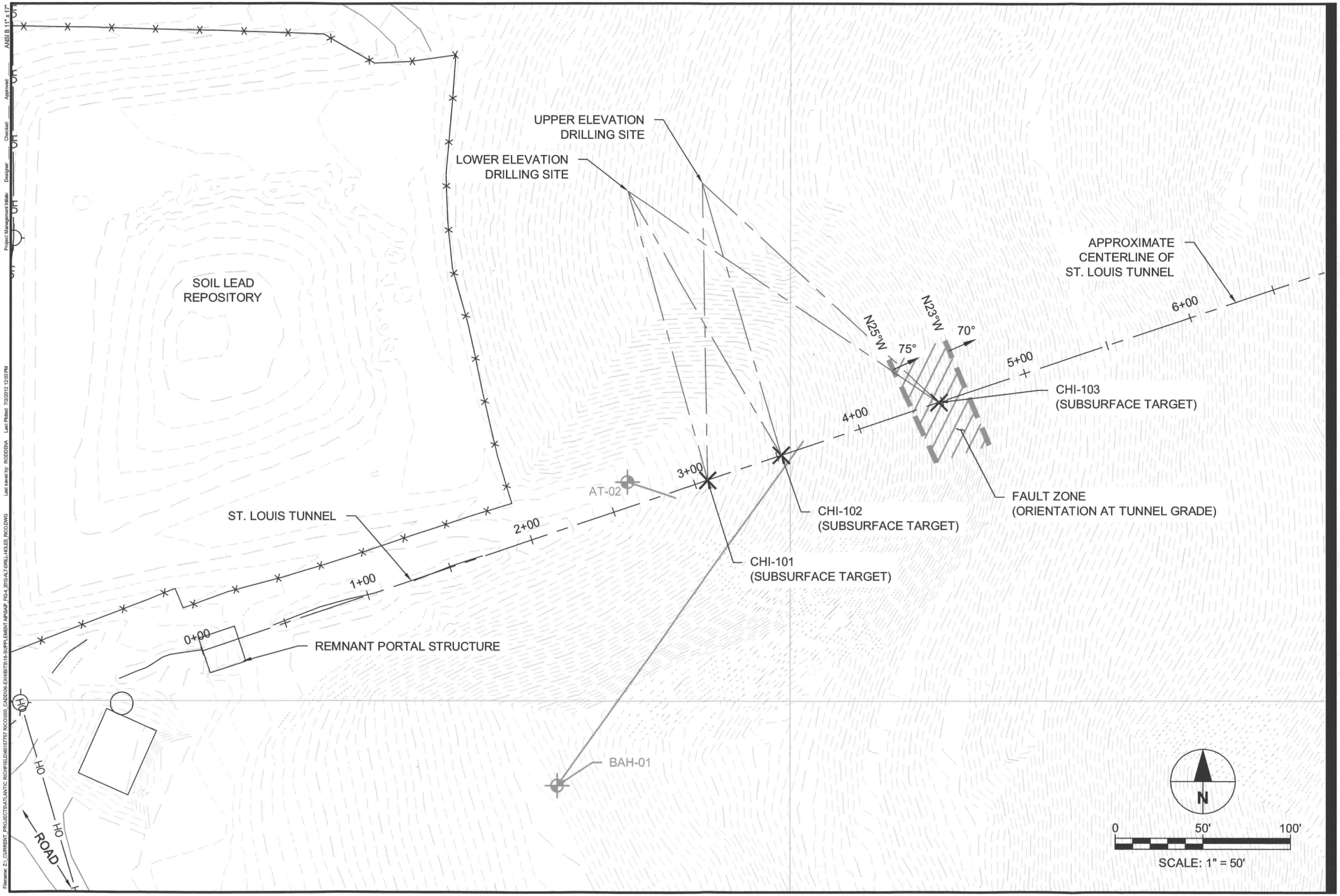

RICO-ARGENTINE SITE-OU01

2012 ADIT INVESTIGATION PLAN SUPPLEMENT

FIGURE 4 - ALTERNATIVE CHI-SERIES DRILL HOLE LOCATIONS

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